APPENDIX 3 - LOCOMOTIVES

Below is additional information pertaining to the Locomotives Category for the South Coast Air Quality Management District's (AQMD's) FY 2003 Carl Moyer Program (CMP). All information in RFP #2004-04 and this Appendix apply. For additional detail regarding this program category, refer to the California Air Resources Board's (CARB's) 2003 Moyer Program Guidelines[1]. In the case of any conflict between CARB guidelines and AQMD criteria, the more stringent criteria will prevail. Also, it is the Applicant's responsibility to check with AQMD's Moyer Program web page for program clarifications, changes and updates. This page may be accessed by clicking the "Clean Air Technologies" link on AQMD's home page at www.aqmd.gov.

INTRODUCTION

While locomotives contribute to California's air pollution problems, they have not been regulated in California until recently. However, locomotives have been subject to various locally enforced opacity limits. Federal law prohibits California from setting standards for new locomotives and new engines used in locomotives. The U.S.EPA, with its sole authority to regulate emissions from locomotives, adopted standards for locomotives that have been phased-in since 2000.

A Memorandum of Understanding (MOU) was signed by CARB and participating railroads, agreeing to a voluntary locomotive fleet average emissions program that will speed the introduction of new, lower-emitting engines in the South Coast Air Basin. **Parties to the South Coast MOU are not eligible for Carl Moyer funds.**

PROGRAM GUIDELINES

Changes For 2003

Below are important changes to the Locomotive category for 2003:

- Table 3.1 has been updated with Baseline NOx emissions for 1990, 2005 & 2010.

- Locomotive Idle Limit Devices (ILDs) and other new advanced technologies such as low-NOx injectors may now be considered for CMP funding under the revised guidelines. See detailed discussion below for additional information.

[1] Be sure to visit http://www.arb.ca.gov/msprog/moyer/moyer.htm for the latest approved CARB Moyer Program Guidelines.

- The cost-effectiveness threshold for the Locomotive category was increased to $13,600 per ton of NOx reduced and the capital recovery factor was reduced to 3 percent.

Project Eligibility Criteria

In general, locomotive projects that meet, at a minimum, the following criteria, would qualify for CMP funding. For locomotive projects involving APUs or ILDs, be sure to review additional criteria in the special ILD section below.

- Projects must result in surplus, real, quantifiable, and enforceable emission reductions over the life of the project.

- All NOx reductions from locomotive engines achieved with Moyer Program funding must be beyond what may be required by any federal, state, or local regulations, memoranda of agreement/understanding, or any other legally binding agreement.

- Locomotive engine emissions must be determined following the most current and approved U.S.EPA emission testing procedures for locomotives.

- Pre-1973 model year locomotive projects must result, based on emissions testing, in a minimum 15 percent reduction of NOx emissions from the uncontrolled baseline levels for the existing engine.

- Model year 1973 and later locomotive projects must meet Federal Tier 1 or Tier 2 locomotive NOx standards based on emissions testing.

- Reduced emission levels must be maintained for the full project life (a minimum of 5 years).

- 75 percent of estimated annual miles traveled and annual fuel consumption must occur in the South Coast Air Basin.

- Costs for labor or parts used during routine maintenance and/or operations are *not* eligible for Moyer Program funding.

- Cost-effectiveness must be no more than $13,600 per ton of NOx reduced.

- Locomotive projects that fall outside of these criteria, such as low-NOx fuel injectors and idle-limit devices (ILD) may be considered on a case-by-case basis if evidence provided to the air district suggests potential, surplus, real, quantifiable and enforceable emission reduction benefits.

Evaluation Methodology

AQMD staff will evaluate all submitted proposals and make recommendations to the Governing Board for final selection of project(s) to be funded. Proposals will be evaluated based on the cost-effectiveness of NOx reduced on an equipment-by-equipment basis, as well as a project's "disproportionate impact" evaluation (discussed below). Be aware of the possibility that due to program priorities and/or funding limitations, project applicants may be offered only partial funding, and not all proposals that meet minimum cost-effectiveness criteria may be funded.

In compliance with AB 1390, Firebaugh, the FY 2003 Moyer Program requires that at least 50 percent of the funds be spent in areas that are disproportionately impacted by air pollution. CARB has issued broad goals and left the details of how to implement this requirement to each air agency. In the South Coast Air Quality Management District, the disproportionately impacted areas are defined by a weighted formula that includes poverty level, particulate matter (PM) exposure and toxic exposure. The process is described below:

1. All projects must qualify for the Moyer Program by meeting the cost-effectiveness limits established in the RFP.

2. All projects will be evaluated according to the following criteria to qualify for Disproportionate Impact funding:

    a. Poverty Level: All projects in areas where at least 10 percent of the population falls below the Federal poverty level based on the year 2000 census data, will be eligible to be included in this category, and

    b. PM Exposure: All projects in areas with the highest 15 percent of PM concentration will be eligible to be ranked in this category. The highest 15 percent of PM concentration is 46 micrograms per cubic meter and above, on an annual average, or

    c. Toxic Exposure: All projects listed in the Multiple Air Toxics Exposure Study in the South Coast Air Basin (MATES II) report[2] as having a cancer risk of 1,000 in a million and above will be eligible to be ranked in this category.

    Data for the poverty level and PM and toxic exposures were obtained from the U.S. Census, the 1998 AQMD monitoring data and Mates II study respectively.

[2] Multiple Air Toxics Exposure Study in the South Coast Air Basin (MATES II), SCAQMD, March 2000.

3. Fifty percent of the $12.3 million available for this RFP will be allocated among proposals located in disproportionately impacted areas. If the funding for disproportionately impacted areas is not exhausted with the outlined methodology, then staff will return to the Governing Board for direction. If funding requests exceed 50 percent of the total available funding, then all qualified projects will be ranked based on their disproportionate impact. Each project will be assigned a score that is comprised of 40 percent for poverty level, and 30 percent each for PM and toxic exposures. Proposals with the highest scores will receive funding until 50 percent of the total funding is allocated.

   All the proposals not awarded under the fifty percent disproportionate impact funding analysis will then be ranked according to cost-effectiveness, with the most cost-effective project funded first and then in descending order for each funding category until the remainder of the Moyer Funds are exhausted. Some projects that exceed the cost-effectiveness ceiling may receive partial funding, depending on their rankings.

Eligible Costs

Eligible project costs (i.e., costs for which Moyer funding is requested) are limited to the incremental cost of a project to implement the reduced emission technology. Please refer to the Project Types section below for additional detail. It is noteworthy that for projects using hours to track annual "activity", the cost of the hour-meter shall be included in the capital cost of the engine for determining an award. Hour-meters are required for ILD projects.

Reporting and Monitoring

All participants in the Carl Moyer Program are required to keep appropriate records during the full life of the project (minimum of 5 years). Records must be retained and updated throughout the project life and made available for AQMD inspection. The AQMD may conduct periodic reviews of each project's operating records to ensure that the locomotive is operated as stated in the project contract. Records must contain, at a minimum:

- locomotive identification numbers;
- retrofit hardware model and serial numbers;
- estimated annual fuel consumption in the South Coast Air Basin;
- hours of operation in the South Coast Air Basin (if emissions calculation is based on hours);
- hours in idling mode (if an ILD project);
- maintenance/repair dates (or any other type of servicing information that is available); and
- any emission testing results.

PROJECT TYPES

New Equipment Purchases

Reliability of a line-haul locomotive engine is extremely important. Since some of the control technologies are costly and have not been in wide use for locomotive engines, line-haul participation in the CMP is not expected until these technologies are proven effective and reliable on passenger, short-line, and switcher locomotive engines. In 2000, when the federal standards took effect, CARB gained the ability to grant experimental permits for operation in California to promising technologies, including alternative fuel locomotive engine operation. Application for an experimental permit is based on evidence submitted by the applicant and meticulous assessment by CARB to ensure that only technologies that offer real emission reductions are deployed. New equipment projects in the locomotive category are eligible and will be evaluated by AQMD and CARB on a case-by-case basis.

Repowers

Repowering can occur during engine remanufacture by exchanging the existing locomotive engine and replacing it with a new or newer, lower-emitting engine. An eligible repower project must result in NOx emission reductions of, at least, 15 percent from the existing engine levels. Emissions must be determined following U.S.EPA-approved test procedures for locomotive engines.

Projects involving a pre-1973 model year locomotive engine must demonstrate NOx emission reductions of, at least, 15 percent below the uncontrolled baseline NOx levels for the existing engine. Baseline emission levels are listed in Table 3.1.

Since there are no line-haul locomotives in service in the South Coast Air Basin with pre-1973 engines, qualifying projects are likely to be for switchers. Projects involving 1973 model year and later locomotives must consist of engines meeting the federal Tier 1 or Tier 2 locomotive NOx standards as listed in Table 3.2 (since Tier O is the baseline for these projects). Engine emission testing must be conducted according to approved federal test procedures for locomotives.

Retrofits

Retrofit involves hardware modifications to the engine that result in lower exhaust emissions. Typical retrofits involve the addition of control equipment or conversion to alternative fuel. CMP funding is available for locomotive retrofit projects that result in real NOx emission reductions and meet a maximum cost-effectiveness of $13,600 per ton of NOx reduced. Similar to repowers, in order to qualify for funding, locomotive engines must be tested to a reduced-NOx emissions level following accepted U.S.EPA test procedures for locomotives.

The allowable NOx emissions limits for line-haul and switcher locomotives using retrofit kits are the same as for repower locomotive projects. Pre-1973 model year locomotive engines must demonstrate NOx emission reductions of, at least, 15 percent below the uncontrolled baseline NOx levels for the existing engine. Baseline emission levels are listed in Table 3.1 above. Projects involving 1973 model year and later locomotives must consist of engines meeting the federal Tier 1 or Tier 2 locomotive NOx standards as listed in Table 3.2.

Replacement of Fuel Injectors

The replacement of fuel injectors with those that provide NOx emission reductions of at least 15 percent will be considered for the CMP. Eligibility is based on the amount of emission reductions and a maximum cost-effectiveness of $13,600 per ton NOx reduced. Similar to repower and retrofit projects, in order to qualify for funding, locomotive engines must be emission tested according to U.S.EPA test procedures for locomotives to determine NOx emission reductions.

Funding for low-NOx fuel injector technology is available for pre-1973 model year switchers or short-line locomotive engines. Only fuel injector technology that has been evaluated or verified by CARB as a NOx reduction strategy is eligible for funding. Stock fuel injectors replaced with those that provide NOx emission reductions normally also produce large particulate matter (PM) emission reductions. Advanced NOx emission reducing fuel injectors are expected to provide fuel savings of approximately 1 to 3 percent.

Since typical fuel injectors have a useful life of approximately one year, the applicant must commit to use the specified low-NOx injectors for the full project life (a minimum of five years), one set per year. The funding allocation will be proportional to the number of years committed to the project by the applicant. The funding allocation will be, at a maximum, for the incremental cost between stock injectors and emission reducing injectors evaluated by CARB. The applicant must also include with their application a signed commitment that the all related engine operating parameters, such as injector timing, remain at the setting used during emission testing. This requirement ensures that the verified 15 percent or greater NOx emission reduction is achieved with the new efficient injectors for the life of the project. These criteria are subject to verification by AQMD at any time. It is suggested that engine timing adjustments that are used to ensure the application-specified NOx emission reduction be accomplished by timing adjustments within the fuel injector itself.

Idle Limit Devices (ILDs)

Locomotive ILDs may be considered on a case-by-case basis for funding under CARB's revised guidelines by both AQMD and CARB. In addition to the applicable program criteria listed for the locomotive category, ILDs will be required to satisfy the Moyer Program requirements similar to those for auxiliary power units (APUs) for heavy-duty vehicles. Those requirements are:

- Eligible projects must provide at least 15 percent NOx emission benefit compared to baseline idling NOx emissions.

- All ILD and any other auxiliary devices must comply with applicable durability and warranty requirements. An engine used for auxiliary power must meet current emission standards and be verified by CARB for sale in California.

- An hour-meter must be installed with the APU or ILD to record the actual operating time of the APU or ILD and to provide information on the number of hours the APU or ILD is utilized. The cost of this hour-meter may be included in the funding request.

- If locomotive idling is offset by an engine used in an APU, the load factor for the APU engine will be its maximum power rating. Another load factor may be proposed and supported by proper documentation for evaluation by AQMD and CARB.

- Funded projects must operate for a minimum of 5 years and emission benefits would be based on the locomotive's idling time of which at least 75 percent must occur in the South Coast Air Basin.

- The lower amount of actual installation costs of the APU or ILD including an hour-meter, or up to a maximum of $1,600 per diesel APU installation and a maximum of $3,100 per ILD, or alternative fuel, electric motor, or fuel cell APU installation may be funded. (See Appendix 8, Auxiliary Power Units for Reducing Idling Emissions from Heavy-duty Vehicles) for additional details.

- The equipment costs of a locomotive-specific ILD up to a maximum of $5,000.

- Projects must meet a cost-effectiveness criterion of $13,600 per ton of NOx reduced.

Advanced Locomotive Technology

Within the switcher industry great advances are being gained in hybrid and battery electric technology. Large NOx and PM emission reductions can be gained from the introduction of hybrid switchers at a cost that may be favorable relative to a new switcher. The applications for such a switcher are numerous.

They include rail switchyards, port facilities, and industrial sites. Fuel use is dramatically reduced, as well as maintenance costs. In addition, battery electric switchers are currently available in the market place as a low horsepower diesel switcher alternative. These switchers utilize rechargeable batteries.

Advanced locomotive technologies that reduce emissions at a cost higher than conventional diesel powered locomotives may be considered for program participation. Similar to other eligible projects, air districts retain the ability to make assessments on a case-by-case basis. Projects deemed meritorious and meeting the cost-effectiveness threshold of $13,600 may be considered for CMP participation.

EMISSION REDUCTION AND COST-EFFECTIVENESS

Emission Standards and Factors

Projects involving a pre-1973 model year locomotive engine must demonstrate NOx emission reductions of, at least, 15 percent below the uncontrolled baseline NOx levels for the existing engine. Baseline emission levels are listed in Table 3.1.

Table 3.1 – Baseline NOx Emission Factors and Maximum NOx Limits (g/bhp-hr).

Engine Model Year	Source	Line-haul	Switcher
Pre-1973	Uncontrolled Baseline Emission Factor	16 [a, b]	16.9 [b]
1973 and later	Baseline Emission Factor	9.5	14.0

[a] Since there are no line-haul locomotives in service in California that are pre-1973, baseline emissions are listed for short-line locomotives only.
[b] CARB emission rates are average estimates based on data provided by engine manufacturers.

Federal standards apply to locomotives originally manufactured in 1973 and later and any time they are rebuilt or remanufactured. Electric locomotives, historic steam-powered locomotives, and locomotives originally manufactured before 1973 are not regulated. Table 3.2 contains the federal exhaust emission standards for locomotives promulgated by the U.S.EPA.

Table 3.2 – Federal Exhaust Emission Standards for Locomotives Beginning in 2000 for New Engines and at Time of Remanufacture

Duty-Cycle	Gaseous and Particulate Emissions (g/bhp-hr)			
	HC	CO	NOx	PM
	Tier 0 (1973 – 2001 model years)			
Line-haul duty-cycle	1.00	5.0	9.5	0.60
Switch duty-cycle	2.10	8.0	14.0	0.72
	Tier 1 (2002 – 2004 model years)			
Line-haul duty-cycle	0.55	2.2	7.4	0.45
Switch duty-cycle	1.20	2.5	11.0	0.54
	Tier 2 (2005 and later model years)			
Line-haul duty- cycle	0.30	1.5	5.5	0.20
Switch duty-cycle	0.60	2.4	8.1	0.24

Emission Reduction Calculation Discussion

Emission reductions for locomotives are based on annual fuel consumption or hours of operation and percent operated in the AQMD. If the applicant provides annual hours of operation, a fuel consumption rate must also be provided. Annual emissions must be estimated separately for the existing baseline engine and the reduced-emission (replacement, new or modified) engine. Baseline activity levels relative to future activity levels must be considered. Annual diesel engine emissions are calculated by multiplying the NOx emission factor by an assumed energy consumption factor shown in Table 3.3, and the estimated annual fuel consumption.

Table 3.3 – Locomotive Default Energy Consumption Factor

Energy Consumption Factor	20.8 bhp-hr/gal

The emission results for both engines are subtracted, multiplied by the percent operated within the South Coast Air Basin (SCAB), and converted from grams to tons.

If annual hours of operation are provided, the annual fuel consumption is calculated by multiplying the fuel consumption rate (gal/hr) by the annual hours of operation (hr/yr). The following formulas must be used when calculating project NOx reductions.

Annual NOx Reductions (tons/year) = [(Ann. Fuel Cons.[3] ** Energy Cons. Factor * Baseline NOx Emissions) – (Ann. Fuel Cons. * Energy Cons. Factor * Reduced NOx Emissions)] * (percent operated in CA) * (1 ton / 907,200 grams);* where,

Ann. Fuel Cons =	Estimated Annual Fuel consumption for the existing and replacement (new or retrofitted) engine (gal/year). If not known, provide annual hours of operation and a fuel consumption rate, and multiply these together for the annual fuel consumption.
Energy Cons. Factor =	20.8 bhp-hr/gal for locomotive diesel.
Baseline NOx Emissions =	NOx emission factor for existing engine (g/bhp-hr).
Reduced NOx Emissions =	NOx Emission factor for replacement (new or retrofitted) engine in g/bhp-hr
Percent operated in CA =	The percent (as a fraction) of time operated in SCAB
Conversion factor:	1 ton = 907,200 grams

Cost-Effectiveness Calculation Discussion

Cost-effectiveness is based on the incremental capital cost, the expected life of the project, the capital recovery factor (CRF) and estimated annual NOx reductions in the AQMD. The amount of incentive funds for the incremental costs of the cleaner technology depends on emission reductions and the C/E limit of $13,600 per ton of NOx reduced.

Only Moyer Program funds are to be used in determining cost-effectiveness[4]. The one-time incentive grant amount is to be amortized over the expected project life (at least five years) at a discount rate of 3 percent. The amortization formula (given below) yields a capital recovery factor (CRF), which, when multiplied by the initial capital cost, gives the annual cost of a project over its expected lifetime.

$$CRF = [(1 + i)^n (i)] / [(1 + i)^n - 1]$$

where

i = discount rate (3 percent)
n = project life (at least 5 years)

Table 3.4 lists the CRF for different project lives using a discount rate of 3 percent. Cost-effectiveness is determined by dividing the annualized costs of a project by the total annual NOx emission reductions offered by the project. The

[3] If annual fuel consumption is not available, calculate it from annual hours of operation and the engine's fuel consumption rate in gallons per hour (i.e., hr/yr * gal/hr = gal/yr).
[4] Unless the AQMD "buy down" the cost of the project by adding additional funding, in which case the total grant funding amount should be used for the cost-effectiveness calculation.

CRF is multiplied by the initial capital cost to give the annual cost of a project over its expected lifetime, as illustrated below.

Annualized Cost (minimum 5 years) = (CRF) (Initial Capital Cost)

Table 3.4 – Capital Recovery Factors (CRF) for Various Project Lives At 3 Percent Discount Rate.

Project Life	CRF
5	0.218
6	0.185
7	0.161
8	0.142
9	0.128
10	0.117
11	0.108
12	0.100
13	0.094
14	0.089
15	0.084
16	0.080
17	0.076
18	0.073
19	0.070
20	0.067

The overall cost-effectiveness of a project is determined by dividing the annualized cost by the annual NOx emission reductions. Cost-effectiveness cannot exceed $13,600 per ton of NOx reduced.

Project Life

As discussed above, a key parameter in the determination of a project's emission reduction benefit is its project life. The acceptable maximum life for calculating the project benefits of locomotive projects is summarized below in Table 3.5.

Table 3.5 – Maximum Project Life for Locomotive Projects

Project Type	Default without Documentation	Default with Documentation
New locomotive	20 years	30 years
Repower or retrofit locomotive	20 years	30 years

The maximum project life for new retrofit technologies such as Idle Limit Devices and Low-NOx injectors is five (5) years, unless approved, based on supporting documentation, by CARB and AQMD.

Project life beyond the "default without documentation" limits may be submitted for approval by CARB.

Example One – Locomotive Engine Retrofit

An operator plans to convert one locomotive engine during the normal remanufacture period. The railroad applies for funding for a locomotive compressed natural gas (CNG) retrofit kit for a 1972 short-line engine. The retrofit kit reduces uncontrolled emissions by 30 percent. Since it is usually about seven years until the next remanufacture, the project life is seven years. The railroad company estimates the remanufacture of the engine without the retrofit kit to be about $890,000. However, the upgrade is more expensive at **$920,000**. The railroad also estimates that the annual fuel consumption for this engine would be approximately **60,000 gals**.

Emission Reduction Calculation

Annual Fuel Consumption:	60,000 gals/year
Baseline NOx Emissions:	16.0 g/bhp-hr (Table 3.1)
Reduced NOx Emissions:	11.2 g/bhp-hr (30% reduction from 16.0 g/bhp-hr)
Energy Cons. Factor:	20.8 bhp-hr/gal (default in Table 3.3)
Percent operated in CA:	100 percent
Conversion factor:	1 ton = 907,200 grams

Estimated annual NOx reductions are:

[(60,000gal/year * 20.8 bhp-hr/gal * 16 g/bhp-hr) – (60,000 gal/year * 20.8 bhp-hr/gal * 11.2 g/bhp-hr)] * 1 ton / 907,200 g) = **6.6 tons/year**

It is assumed that the replacement CNG retrofit has the same equivalent annual fuel consumption (60,000 gals/yr) and **energy consumption factor (20.8 bhp-hr/gal)** as the existing diesel engine. The capital and incremental costs and benefits can be calculated as follows:

Cost and Cost-Effectiveness Calculations

Capital Costs for remanufacture without Upgrade	$ 890,000
Capital costs for remanufacture with retrofit kit	$ 920,000
Incremental Project Cost:	($ 920,000 - $ 890,000) = $ 30,000
Capital Recovery Factor:	0.161 (from Table 3.4)
Annualized Cost:	($ 30,000) * (0.161) = $ 4,830/yr
Cost-effectiveness:	($ 4,830/yr) / (6.6 ton/yr) = **$ 732/ ton of NOx reduced**

The project meets the cost-effectiveness limit of $13,600 per ton NOx reduced. This project would qualify for the maximum amount of grant funds requested.

Example Two – Locomotive Engine Replacement

An operator plans to replace a short-line locomotive engine during the normal remanufacture period. The railroad applies for funding to replace a 1983 **short-line** locomotive engine (9.5 g/bhp-hr NOx) with a liquefied natural gas (LNG) engine (4.0 g/bhp-hr NOx). The railroad company estimates a project life of 20 years for the LNG engine. The railroad company also estimates the normal remanufacture costs for the engine to be about $890,000. The LNG upgrade costs are $1.2 million. The railroad also estimates that the annual hours of operation for the new engine to be 1000 hours per year, with an average fuel consumption rate of 17.5 diesel equivalent gallons per hour. The annual fuel consumption of the existing engine is 14,000 gal/yr. The locomotive will operate 100 percent of the time in the AQMD. Emission reductions are calculated as follows:

Emission Reduction Calculation

Replacement Engine Annual Fuel Consumption:	1000 hr/yr * 17.5 gal/hr = 17,500 gal/yr
Baseline NOx Emissions:	9.5 g/bhp-hr (Table 3.2)
Reduced NOx Emissions:	4.0 g/bhp-hr
Energy Consumption Factor:	20.8 bhp-hr/gal (default in Table 3.3)
Percent operated in AQMD:	100 percent
Conversion factor::	1 ton = 907,200 grams

Estimated annual NOx reductions are:

[(14,000 gal/yr * 20.8 bhp-hr/gal * 9.5 g/bhp-hr) - (17,500 gal/yr * 20.8 bhp-hr/gal * 4.0 g/bhp-hr)] * 1 ton / 907,200 g = **1.44 tons/year**

Cost and Cost-Effectiveness Calculations

Capital Costs for remanufacture without Upgrade	$890,000
Capital costs for LNG engine	$1,200,000
Incremental Project Cost:	**$** 1,200,000 - $ 890,000 = $ 310,000
Capital Recovery Factor:	0.067 (from Table 3.4)
Annualized Cost:	($ 310,000) * (0.067) = $ 20,770/yr
Cost-Effectiveness:	($ 20,770/yr) / (1.44 ton/yr) = **$ 14,424/ ton of NOx reduced**

The cost-effectiveness for the example is greater than the $13,600 limit. In order to meet the $13,600 per ton cost-effectiveness requirement, this project would only qualify for part of the incremental cost - a maximum amount of approximately $292,300[5].

Example Three – Switcher Locomotive Fuel Injector Upgrade

A company plans to replace a model year 1972, 16 cylinder, switcher locomotive's fuel injector during the normal fuel injector replacement period with

[5] The maximum allowable award may be "back-calculated" as follows: Award = [(Cost-Effectiveness) * (tons/yr)] / CRF. In this example: $13,600 * 1.44 / 0.067 = $292,298.

those that reduce fuel consumption by 1 to 3 percent and NOx emissions by 15 percent at a cost of $675 per cylinder. The railroad applies for funding to cover the incremental cost of the new, low-NOx, more efficient injectors relative to the cost of stock injectors. The typical lifetime for locomotive diesel injectors is approximately 6,000 hours or one year of typical usage. Therefore, the railroad company must commit to use the new efficient injectors for a minimum of five years. The railroad buys new injectors for their switcher every year at a cost of $137 per cylinder. The railroad estimates that the pre-1973 switcher consumes 53,000 gallons of diesel fuel per year.

Emission Reduction Calculation

Baseline Annual Fuel Consumption:	53,000 gal/yr
Alternative Annual Fuel Consumption:	51,940 gal/yr (2 percent fuel savings due to advance injectors)
Baseline NOx Emissions:	16.9 g/bhp-hr (Table 3.1)
Reduced NOx Emissions:	14.4 g/bhp-hr (15 percent reduction)
Energy Consumption Factor:	20.8 bhp-hr/gal
Percent operated in AQMD:	100 percent
Conversion factor:	1 ton = 907,200 grams

Estimated annual NOx reductions are:

[(53,000 gal/year * 20.8 bhp-hr/gal * 16.9 g/bhp-hr) - (51,940 gal/year * 20.8 bhp-hr/gal * 14.4 g/bhp-hr)] * 1 * ton / 907,200 g = **3.4 tons/year**

Cost and Cost-Effectiveness Calculations

Costs for stock injectors for 5 years:	$10,960 ($137/cyl * 16 cyl * 5 yrs)
Costs for efficient injectors for 5 years:	$54,000 ($675/cyl * 16 cyl * 5 yrs)

Incremental Project Cost:	**$** 54,000 - $ 10,960 = $ 43,040
Capital Recovery Factor:	0.218 (from Table 3.4)
Annualized Cost:	($ 43,040) * (0.218) = $ 9,383/yr
Cost-Effectiveness:	($ 9,383/yr) / (3.4 tons/year) = **$2,760/ton of NOx reduced**

The project meets the cost-effectiveness limit of $13,600 per ton NOx reduced. This project would qualify for the maximum amount of grant funds requested.

Example Four – Short-line Locomotive Idle Limit Device Retrofit

An applicant plans to install an idle limit device (ILD) on a model year 1981 locomotive during routine maintenance. The rail company estimates that the locomotive idles about 47 percent of the total operating time. During that idle time, 20,000 gallons of diesel fuel are consumed. It is estimated that idle time can be reduced by 50 percent by the ILD, thereby, saving 10,000 gallons of fuel per year. The estimated life for this ILD is 10 years. CARB and AQMD approval was obtained by the applicant to use a ten-year life for the project.

Emission Reduction Calculation

Annual Fuel Consumption Reduced:	10,000 gal/yr
NOx Emissions Factor:	9.5g/bhp-hr (Table 3.2)
Energy Consumption Factor:	20.8 bhp-hr/gal
Percent operated in AQMD:	100 percent
Conversion factor:	1 ton = 907,200 grams

Estimated annual NOx reduction are:
[(10,000 gal/year * 20.8 bhp-hr/gal * 9.5 g/bhp-hr)*(1 ton / 907,200 g)] = **2.2 tons/year**

Cost and Cost-Effectiveness Calculations

Capital Costs for idle limit device	$8,000
Cost for installation	$4,000

Project Cost:	$8000 + $ 4000 = $ 12,000
Maximum Amount Funded:	($5,000 + $3,100) = $ 8,100
Capital Recovery Factor:	$[(1 + 0.03)^{10} (0.03)]/[(1 + 0.03)^{10} – 1] = 0.117$
Annualized Cost:	($8,100) * (0.117) = $ 948/ year
Cost-Effectiveness:	($948 /yr) / (2.2 ton/yr) = **$ 431/ ton of NOx reduced**

The project meets the cost-effectiveness limit of $13,600 per ton NOx reduced. This project would qualify for the maximum amount of grant funds requested.

Carl Moyer Memorial Air Standards Attainment Program
LOCOMOTIVE ENGINE
APPLICATION

Please provide all information requested regarding your proposed purchase and application. Additional information may be requested during the review process. Applicant acknowledges that award of cash incentive is subject to AQMD approval and must meet the minimum eligibility criteria within the project category. **Please Print or Type**

A. APPLICANT INFORMATION		
Organization/Company Name:		
Business Type:	Number of Locomotive Engines in Fleet:	
Project Name:		
Street/Mailing Address:		
City:	State:	Zip Code:
Project Location Address (if different from above):		
City:	State:	Zip Code:
Contact Name:		
Phone: ( )	Fax: ( )	
E-mail:		
Geographic area served by Organization/Company:		
Geographic area served by Locomotive (if different from above):		
Number of Locomotive Engines to be Replaced/Retrofitted:		

I hereby certify that all information provided in this application and any attachments is true and correct.

Number of Engines Requested for Funding:	Total Funding Request:
Printed Name of Responsible Party:	Title:
Signature of Responsible Party:	Date:

CHECK LIST FOR APPLICATION ITEMS

Be sure the following items are included with your application submittal. Check each applicable item below to indicate inclusion of material.

- ❑ Completed Application Forms
- ❑ Checklists for Application Items and Eligibility Criteria
- ❑ Letter of Agreement from Fuel Provider (if applicable)
- ❑ Project cost information (as described in the RFP), which shall include vendor quotes or other documentation substantiating cost data provided in the Application.
- ❑ Contracting Statements (Applications are not eligible without this form.)
    - ❑ Statement of Understanding for Work Statement and Deliverables
    - ❑ Conflict of Interest Statement (as described in the RFP)
    - ❑ Third-Party Application Submittal Authorization (Only required if application is submitted by someone other than the vehicle/equipment owner.)
- ❑ Co-funding information (if applicable).
- ❑ Certifications and Representations
- ❑ Other (attach explanation)

If you have any questions regarding the application process for Locomotive Engine projects, please contact Connie Day, Science & Technology Advancement at (909) 396-3055 by phone, or (909) 396-3252 by fax.

REMINDER

Due Date - The proposer shall submit **six (6) complete copies of the proposal** in a sealed envelope, plainly marked in the upper left-hand corner with the name and address of the proposer and the words "Request for Proposals #2004-04." All proposals are due no later than 5:00 p.m., on Friday, October 10, 2003. Postmarks are not accepted. **Faxed or e-mailed proposals will not be accepted**. Proposals must be directed to:

Procurement Unit
South Coast Air Quality Management District
21865 East Copley Drive
Diamond Bar, CA 91765

CONTRACTING STATEMENTS (All Are Required)

1. Statement of Understanding for Work Statement and Deliverables

In order to minimize the effort required to complete a Moyer Program Application, AQMD does not require submittal of a Work Statement or Deliverables Summary with the Application. However, the undersigned confirms full understanding that, if awarded funding under the Carl Moyer Program, development and submittal of the detailed work statement, with deliverables and schedule, is a requirement of the contracting process. Recommended projects will not receive funding without these documents. Full details of the Work Statement and Deliverables requirements are detailed in RFP #2004-04. In addition, Baseline and Reduced Emission Vehicle Serial/VIN information must be provided at contract start. By signing below, the applicant acknowledges these requirements.

2. Conflict of Interest Statement

Please address any potential conflicts of interest with other clients affected by actions performed by the firm on behalf of the AQMD in the form of a Conflict of Interest Statement. Although the proposer will not be automatically disqualified by reason of work performed for such firms, the AQMD reserves the right to consider the nature and extent of such work in evaluating the proposal. Conflicts of interest will be screened on a case-by-case basis by the AQMD District Counsel's Office. Conflict of interest provisions of the state law, including the Political Reform Act, may apply to work performed pursuant to this contract. Please provide a Conflict of Interest Statement below. If additional room is necessary, please attach extra pages to this sheet.

3. Third-Party Application (Circle One: Applicable Not Applicable)

Applicants who are submitting on behalf of a vehicle/equipment owner must provide authorization from the vehicle/equipment owner to act on their behalf for this application process. This authorization shall be provided in the form of a "Letter of Exclusive Authorization", to be attached to this sheet. In addition, the vehicle/equipment owner shall enter into a contract with its authorized applicant, who will sign a contract with AQMD for fulfilling all contract obligations.

Organization:	
Printed Name of Responsible Party:	Title:
Signature of Responsible Party:	Date:

CHECK LIST FOR ELIGIBILITY CRITERIA

Please check each applicable item to indicate eligibility of proposed locomotive engine technology.

❑ The locomotive engine is 50 horsepower or greater.

Check applicable categories below:

The reduced-emission engine/technology:

- ❑ is certified for sale in California;
- ❑ meets the minimum NOx emission reduction requirement, with no increase in particulate matter emissions, compared to the applicable standards or emission levels for that engine year and type of application through:
  - ❑ California Air Resources Board (ARB) certification testing, or
  - ❑ U.S. EPA certification testing, or
  - ❑ Emission testing at a laboratory approved by the U.S. EPA or the CARB;

And

A. For new locomotive projects:
   - ❑ The new engine must be certified by CARB to achieve at least 30 percent NOx, or NOx+NMHC, emission reductions, or
   - ❑ These projects will be evaluated by AQMD and CARB on a case-by-case basis.

B. For locomotive repower projects:
   - ❑ The replacement engine must be certified to the current emission standards applicable for that engine, and is at least 15 percent lower than the NOx, or NOx+NMHC, emission level of the engine being replaced, or

C. For retrofit kit or add-on projects:
   - ❑ shows at least a 15 percent reduction of NOx, or NOx+NMHC, emissions, and no increase in particulate matter emissions, compared to the applicable standards for that engine year and application type.
   - ❑ The retrofit technology is warranted by retrofit manufacturer and/or authorized dealer.

❑ The purchase, or emission reduction, is not required by any local, state, or federal rule or regulation, Memorandum of Understanding (MOU) or Memorandum of Agreement (MOA), or used to comply with any such rule or regulation, MOU or MOA.

LOCOMOTIVE ENGINE APPLICATION

For <u>each</u> engine that you plan to repower/retrofit, complete and attach the appropriate forms. <u>Please check one:</u>

- ❑ Purchase of a new locomotive engine.
- ❑ Repowering a locomotive with a new reduced-emission engine (replacement).
- ❑ Retrofitting a locomotive engine with a new reduced-emission technology.

B. GENERAL INFORMATION ABOUT EACH ENGINE FOR REPOWER OR RETROFIT	
1. Number of engines to be purchased/retrofitted:	
2. Fuel type:	
3. Primary function of each locomotive (e.g. short line, switch yard, line haul, or passenger):	
4a. Estimated total annual hours of operation:	4b. Percent within AQMD:
5a. Estimated total annual mileage:	5b. Percent within AQMD:
6. Estimated total annual ton-miles:	
7. Estimated annual fuel consumption/rate (in gallons or gallons/hour) for each locomotive:	8. Incentive Amount Requested:
9. Estimated Project life:	
10. Is there any seasonality to the use of the locomotive? <u>YES/NO</u> If Yes, please explain:	

CURRENT LOCOMOTIVE/ENGINE	**NEW REDUCED EMISSION ENGINE/RETROFIT**
11. Model year:	Model year: *Same as current*
12. Engine make:	Engine make:
13. Engine model year:	Engine model year:
14. Engine model number:	Engine model number:
15. Serial number of engine:	Serial number of engine: (to be provided when available)
16. Horsepower:	Horsepower:
17. Injector Type	Injector Type

LOCOMOTIVE APPLICATION SECTION (*continued*)

17 a. Estimated locomotive engine life (yrs): b. Estimated engine life remaining (yrs): c. Estimated dollar value:	Estimated locomotive engine life (yrs):
18. Typical remanufacture/replacement schedule:	Typical remanufacture/replacement schedule:
19. Cost of remanufacture w/out control upgrade: $	Cost of remanufacture with control upgrade: $
20. Baseline NOx Emission Level (g/bhp-hr)	Controlled NOx emission Level (g/bhp-hr):
21. Baseline PM[6] emission Level (g/bhp-hr):	Controlled PM emission Level (g/bhp-hr):

Complete the appropriate information, then go to Section F.

E. GENERAL INFORMATION ABOUT THE INSTALLER

LOCOMOTIVE ENGINE FOR REPOWER (replacement)	
Engine installer:	
Street address:	
City:	State:
Phone: ( )	Fax: ( )
Contact name:	

OR

[6] PM emission factors are provided in RFP #P2004-04 in the Particulate Matter Discussion Section.

LOCOMOTIVE APPLICATION SECTION (*continued*)

RETROFIT OR OTHER NOx EMISSION REDUCTION TECHNOLOGY (i.e., Idle Limit Devices, Low-NOx Injectors, etc.)	
Retrofit manufacturer:	
Retrofit Installer:	
Installer street address:	
City:	State:
Phone: ( )	Fax: ( )
Contact name:	Retrofit kit number:
Description of retrofit technology:	

All applicants must complete this section.

F. OTHER INFORMATION

MAINTENANCE
Describe your maintenance facility and practices, including any training regarding the low-emission technology. If the training has not been completed, provide a timeline for completion.

REFUELING (for alternative fuels)
Describe how and where the locomotive will be refueled (e.g. on-site, existing facility, mobile/skid mounted equipment, etc.) Attach written verification of access to refueling facility.